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$$= \frac{2}{3} \frac{\phi}{\psi} \left[ 1 + \frac{\phi^2}{6} - \frac{\phi^2}{6} + \frac{\phi^4}{36} - \frac{\phi^4}{120} + \frac{\phi^4}{120} - \frac{\phi^2 \phi^2}{36} \right] \dots$$

$$\text{So, } \frac{\tan \phi}{\tan \psi} = \frac{1}{3} \frac{\phi}{\psi} \left[ 1 + \left( \frac{\phi^2}{3} + \frac{2\phi^4}{15} \right) \right] \left[ 1 + \left( \frac{\psi^2}{3} + \frac{2\psi^4}{15} \right) \right]^{-1} \dots$$

$$= \frac{1}{3} \frac{\phi}{\psi} \left[ 1 + \frac{\phi^2}{3} - \frac{\phi^2}{3} - \frac{2\psi^2}{15} + \frac{\phi^4}{9} + \frac{2\phi^4}{15} - \frac{\phi^2 \psi^2}{9} \right] \dots$$

$$\text{Their sum} = \frac{\phi}{\psi} \left[ 1 + \frac{\phi^4}{180} - \frac{10\phi^2 \psi^2}{180} + \frac{9\phi^4}{180} \right] \dots$$

$$= \frac{\phi}{\psi} + \frac{\phi}{\psi} \cdot \frac{1}{180} [\phi^2 - \psi^2] [9\phi^2 - \psi^2].$$

In Mr. Greenwood's solution it will be noticed that  $\frac{\tan \phi}{\tan \psi}$  is *not*  $AB$  as stated.

The relation  $\tan \phi = \phi + \frac{1}{3}\phi^3 + \frac{2}{15}\phi^5 + \frac{17}{315}\phi^7 \dots$  is readily obtained from

$$\tan \phi = \left[ \phi - \frac{\phi^3}{6} + \frac{\phi^5}{120} - \frac{\phi^7}{5040} + \dots \right] \left[ 1 - \frac{\phi^2}{2} + \frac{\phi^4}{24} - \frac{\phi^6}{720} + \dots \right]^{-1}$$

$$\text{The second factor} = \left[ 1 + \left( \frac{\phi^2}{2} - \frac{\phi^4}{24} + \frac{\phi^6}{720} \right) + \left( \frac{\phi^2}{2} - \frac{\phi^4}{24} \right)^2 + \left( \frac{\phi^2}{2} \right)^3 + \dots \right]$$

and on multiplying out the expansion is obtained to any power we require.

## PROBLEMS FOR SOLUTION.

### NUMBER THEORY AND DIOPHANTINE ANALYSIS.

157. Proposed by A. H. HOLMES, Brunswick, Maine.

Find integral values for  $m$  and  $n$  in  $64m^2n^2(m^2 - n^2)^2 + (m^2 + n^2)^4 = \square$ .

158. Proposed by J. EDWARD SANDERS, Reinersville, Ohio.

Find positive rational values of  $a$  and  $b$  in the equation  $x^4 - 2ax^2 + x + a^2 - b = 0$ , that will make each of the roots (all different) rational numbers.